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(71) Applicant *(for all designated States except US)*: MASONITE CORPORATION [US/US]; 1955 Powis Road, West Chicago, IL 60185 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: WALSH, John, P. [US/US]; 117 South Third Street, St. Charles, IL 60174 (US). VERGARA, Alex [US/US]; 802 Manley Road, St. Charles, IL 60174 (US).

(74) Agents: HAERTER, Martin, W. et al.; Darby & Darby P.C., 805 Third Avenue, New York, NY 10022–7513 (US).

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(54) Title: POST-PRESS MOLDING OF FIBERBOARD DOOR SKINS

(57) Abstract

In a method of forming a contoured panel from a previously manufactured flat composite board, a medium density fiberboard blank having a known caliper and gravity is subjected to steam injection to increase the moisture content of the blank. Increasing the moisture content of the blank softens the blank to prevent cracking in subsequent pressing operations. After the moisture content of the mat is increased in a range of 2.5–10 %, the blank is molded between contoured molding dies with sufficient heat and pressure to form a hardened, contoured panel having a caliper less than the medium density fiberboard blank and having a gravity greater than the medium density fiberboard blank. The contoured panel is suitable for use as a door skin.

POST-PRESS MOLDING OF FIBERBOARD DOOR SKINS

BACKGROUND OF THE INVENTION

This invention relates to "post-press" processing of a previously manufactured man made board, and in particular, a post-press process for economically molding previously manufactured man made board into highly contoured products. The invention is further directed to the post-press molding of medium density fiberboard, commonly referred to as MDF, to provide a normally flat board with a deeply contoured shape. More particularly, the process of the present invention relates to the molding of MDF in a post press molding step to provide "raised panel" door skins for making doors.

The demand for man made board products has risen steadily in recent years, particularly in the construction industry, due primarily to the dwindling supplies and high cost of solid dimensional lumber. In addition to low cost and plentiful supply, man made board provides other advantages over natural wood, such as, high strength, dimensional stability, and durability. Molded or contoured man made board products are particularly important due to the economy of manufacture provided by molding processes that take advantage of minute scraps of wood, as compared to waste intensive milling of contoured solid wood products. Thus, the manufacture of man made board has taken on a new significance as producers seek cost effective methods of manufacturing high quality contoured products.

Door manufacture in particular has become an area of intense effort. Laminated construction doors having a plywood or hardboard core sheathed with contour molded fiberboard "skins" give the appearance of being traditional solid wood raised panel doors. These laminated doors can be manufactured at a substantially lower cost than a traditional solid wood door, and provide better dimensional stability and durability. However, efforts to reduce door manufacturing costs by making contoured door skins from previously manufactured flat fiberboard, such as, for

example, low density fiberboard (LDF) or MDF, have met with limited success. LDF, although suitable in molding characteristics, is not readily available as a market commodity. MDF is an abundantly available market commodity, but when it is subjected to post-press molding, it cracks readily unless costly methods are practiced to prevent cracks.

The manufacture of contoured or shaped man made board products has involved two categories of processes of manufacture, single-press and post-press processing. In a first process category, hereinafter referred to as the single press process, contoured man made board products are manufactured from raw materials by providing a thick (3-4 inch), pulp mat which is consolidated to a thickness of approximately 1/4 inch under heat and pressure in a mold having a desired shape. The single press process has the advantage of producing highly contoured products. However, the single press process has the disadvantage of requiring a high capital investment for the specialized machinery and facilities necessary to carry on the process. The initial capital investment required for the single press process is conservatively estimated to be fourteen times that of the post press process of the present invention.

In a second process category, the post-press process, heat, pressure, bonding agent or chemical treatment are applied alone or in various combinations to a previously manufactured man made board to provide contours to the generally planar board. For the purpose of this application, post-press processing of a man made board refers to processing after initial manufacture and consolidation of the board, i.e., after the board has already been subjected to the usual production processes. Post-press processes using heat and pressure are known, but the processes may require chemical treatment, and can generally only be used with particularly soft fiberboard, i.e., LDF, not MDF. As noted above, LDF, although more malleable is not a commonly available market commodity. Furthermore, the known heat/pressure processes either do not result in highly contoured products, or if they do result in highly contoured products, require expensive presses having high operating pressure. The known chemical/pressure processes suffer similar drawbacks and have the further disadvantages associated with noxious chemicals, such as, for example, high cost, safety, disposal and environmental hazard concerns.

Overall, the post-press process has the advantage of higher

manufacturing economy due to lower initial and daily operating costs. Furthermore, certain categories of previously manufactured man made boards, such as, for example, MDF, are readily and cheaply available as market commodities, therefore providing a ready source of blanks for post-press processing. However, post-press processing of MDF has, until now, not been able to provide highly contoured products. Attempts to manufacture highly contoured products by post-press processing of MDF have failed in the past due to cracking and other problems associated with the breaking of inter-fiber bonds established during the first consolidation.

The applicant has discovered that the problems in the prior art, e.g. expensive facilities and equipment, unavailability of material, low contouring, noxious chemical treatments, etc., can be overcome, and that a "standard" MDF can be post-press formed to have substantial contours if the MDF is provided in a certain density and thickness range, and if the MDF is softened by steam injection before pressing.

SUMMARY OF THE INVENTION

The process of the present invention comprises the steps of selecting a MDF of a particular density and thickness range, softening the MDF by wetting with water or steam to a degree sufficient for reshaping without cracking, and subjecting the MDF to heat and pressure sufficient to permanently reshape the MDF.

Accordingly, an object of the present invention is to provide an improved method of post-press forming standard MDF to have substantial contours without forming cracks.

Another object of the invention is to provide an improved method for making door skins having substantial contours from standard MDF.

These and other objects and advantages of the present invention will be better understood with reference to the following detailed description of the invention.

DETAILED DESCRIPTION

For effective post-press molding of previously manufactured MDF, it has been found that, prior to hot pressing, it is necessary to soften the MDF to an extent sufficient to prevent cracking during and/or after pressing.

MDF blanks having a caliper of 0.225 inch and gravity of 0.70 g/cm^3 (typical of MDF) are pressed to form contoured finished door skins having a caliper of

0.160 inch and a gravity of 0.96 g/cm^3. To achieve a finished product having a caliper of 0.160 inch, the press platens may need to be closed to a smaller dimension, such as, for example, 0.110-0.120 inch to accommodate for the "spring back" inherent in pressed fibre board products. It will be appreciated by those skilled in the art that the caliper and gravity of the MDF blanks and the finished door skins can vary substantially from the recited figures, without departing from the spirit and scope of the invention, to accommodate the differences in MDF blanks available on the market, and to accommodate the various final applications to which the door skin products may be applied. The MDF blanks can be made of an well known hardwood, softwood, lignin or wood by-product, to industry standard specifications and/or dimensions, or the MDF can be prepared in specifications and/or dimensions specifically for making door skins. The preferred urea formaldehyde content of the MDF is 10%.

The MDF can be most effectively softened by subjecting it to one or more of the following treatments: exposure to steam in an appropriate chamber; steam injection; or exposure to water spray.

Steam injection is the preferred treatment for several reasons. Steam injection yielded the best appearance in the finished products and yielded the fastest treatment (softening) time. Steam injection is capable of providing a 5% moisture content increase in the MDF in 20 seconds. Furthermore, steam injection treatment is readily adaptable to the manufacturing process conveyor for making door skins from MDF blanks. Process lines having steam injection treatment for the manufacture of other fiberboard products, such as, for example, building siding, are already known. The steam injection can be supplied by any of a number of well known methods and apparatus, such a platens provided with numerous apertures and channels to deliver steam under pressure to an MDF blank before the blank enters the final contour mold, or the final mold itself can serve as a steam injection platen. The steam injection can be provided to one or both sides of an MDF blank, and alternatively, a low pressure zone or vacuum can be applied to portions of the MDF blank to draw the injected steam through the blank.

The steam is preferably injected into the MDF blanks at a pressure in a range from 50 to 100 psi from steam platens heated in a range from 180°F to 450°F. The higher pressure is preferred to speed the softening process. A steam platen temperature of 200°F is preferred to provide wet steam which in turn provides, for

example, a 5% moisture pickup in 20 seconds. The steam injection cycle can fall in the range of 15 to 180 seconds, however, since the preferred cycle time for the contour press is 70 seconds, the steam cycle time should preferably be 70 seconds or less. The steam is injected until a moisture content preferably in a range of 2.5% to 10% is achieved. However, moisture content outside of that range is also contemplated in circumstances which demand more or less moisture content, such as, for example, to accommodate fiber and/or resin content variation in a commercially available MDF.

The water spray is also provided to the MDF blank by conventional processes and apparatus. The water spray is delivered at a preferred rate of 20g to one or both surfaces of the MDF blank. A surfactant may be mixed with the water to improve water absorption by the MDF blank. Or the water may be provided in a solution of 20% urea to enhance the softening properties of the MDF.

The softening of MDF by the provision of steam in a chamber is the slowest softening treatment (2 minutes minimum) means, and the least favored in terms of equipment and facilities required. Provision of steam generally requires a steam chamber separate and apart from the product process line. To ensure proper moisture content, the MDF blanks must be exposed to the steam in the chamber for at least two minutes. Then the exposed blanks must be transported to the process line for pressing and finishing. In contrast, the steam injection and/or water spray treatments can be incorporated into the product process line to speed processing and reduce handling of the blanks.

While the MDF blank is being sufficiently softened, or after being sufficiently softened, the MDF blank is moved into the dies of the contour mold. The platens of the contour mold are heated to a temperature in a range from 180°F to 450°F, preferably 350°F to 450°F, with the die surface temperature slightly below the platen temperature. The dies engage the MDF blank with a pressure in the range from 1000 psi to 4500 psi, with the preferred range from 2500 psi to 3500 psi. Cycle time for the press is 15 seconds to 200 seconds, with the preferred cycle time being 70 seconds.

A thin paper overlay may be applied to the MDF during processing to provide a wood-like grain or other textured finish to the final door skin product. Crepe paper provides a natural wood grain texture to the MDF.

It will be obvious to those skilled in the art that variations and modifications of the disclosed embodiments of the invention may be made without departing from the spirit and the scope of the invention as defined herein.

What Is Claimed Is:

1. A method of forming a contoured panel from a previously manufactured medium density fiberboard blank, the method comprising the steps of:

selecting the medium density fiberboard blank having a caliper and a gravity;

increasing a moisture content of the medium density fiberboard blank to sufficiently soften the blank so that cracking of the medium density fiberboard blank during molding and after molding is prevented; and

molding the medium density fiberboard blank between opposing contoured molding dies with sufficient heat and pressure to form the contoured panel having a caliper less than the caliper of the medium density fiberboard blank and a having a gravity greater than the gravity of the medium density fiberboard blank.

2. The method of forming the contoured panel of claim 1 wherein the moisture content of the medium density fiberboard blank is increased to an amount in the range of 2.5%-10%.

3. The method of forming the contoured panel of claim 1 wherein the moisture content of the medium density fiberboard blank is increased by injecting steam under pressure into the blank.

4. The method of forming the contoured panel of claim 3 wherein the steam is injected at a pressure in the range of 50-100 psi.

5. The method of forming the contoured panel of claim 3 wherein the steam is injected from steam platens heated to a temperature in a range from 180°F to 450°F.

6. The method of forming the contoured panel of claim 3 wherein the steam is injected for a period in the range of 15-180 seconds.

7. The method of forming the contoured panel of claim 3 wherein the steam is injected for a period of 70 seconds.

8. The method of forming the contoured panel of claim 1 wherein the molding dies engage the medium density fiberboard blank with the increased moisture content with a pressure in the range from 2500 to 3500 psi.

9. The method of forming the contoured panel of claim 1 wherein the cycle time for the press is in the range from 15-200 seconds.

10. The method of forming the contoured panel of claim 1 wherein the moisture content of the medium density fiberboard blank is increased by exposure to steam in a steaming chamber.

11. The method of forming the contoured panel of claim 1 wherein the moisture content of the medium density fiberboard blank is increased by spraying water on at least one side of the blank.

12. The method of forming the contoured panel of claim 11 wherein the water is sprayed at a rate of 20g.

13. The method of forming the contoured panel of claim 11 wherein a surfactant is added to the water prior to spraying.

14. The method of forming the contoured panel of claim 11 wherein urea sufficient to enhance softening of the blank is added to the water prior to spraying.

15. The method of forming the contoured panel of claim 14 wherein the urea is provided in a 20% solution in the water.

16. A method of forming a contoured panel from a previously manufactured medium density fiberboard blank, the method comprising the steps of:

selecting the medium density fiberboard blank having a caliper of 0.225 inch and a gravity of 0.70 g/cm^3;

increasing a moisture content of the medium density fiberboard blank to

sufficiently soften the blank so that cracking of the medium density fiberboard blank during molding and after molding is prevented; and

molding the fiberboard between opposing contoured molding dies with sufficient heat and pressure to form the contoured panel having a caliper of 0.160 inch and a gravity of 0.96 g/cm^3.

17. The method of forming the contoured panel of claim 16 wherein the moisture content of the medium density fiberboard blank is increased to an amount in the range of 2.5%-10%.

18. The method of forming the contoured panel of claim 16 wherein the moisture content of the medium density fiberboard blank is increased by injecting steam under pressure into the blank.

19. The method of forming the contoured panel of claim 18 wherein the steam is injected at a pressure in the range of 50-100 psi.

20. The method of forming the contoured panel of claim 18 wherein the steam is injected from steam platens heated in a range from 180°F to 450°F.

21. The method of forming the contoured panel of claim 18 wherein the steam is injected for a period in the range of 15-180 seconds.

22. The method of forming the contoured panel of claim 18 wherein the steam is injected for a period of 70 seconds.

23. The method of forming the contoured panel of claim 1 wherein the medium density fiberboard blank has a caliper of 0.225 inch and a gravity of 0.70 g/cm^3, and the hardened, contoured door skin has a caliper of 0.160 inch and a gravity of 0.96 g/cm^3.